

CEOS IVOS 31

# EROS CalVal Landsat Update

Date: 2019/03/28

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# Outline

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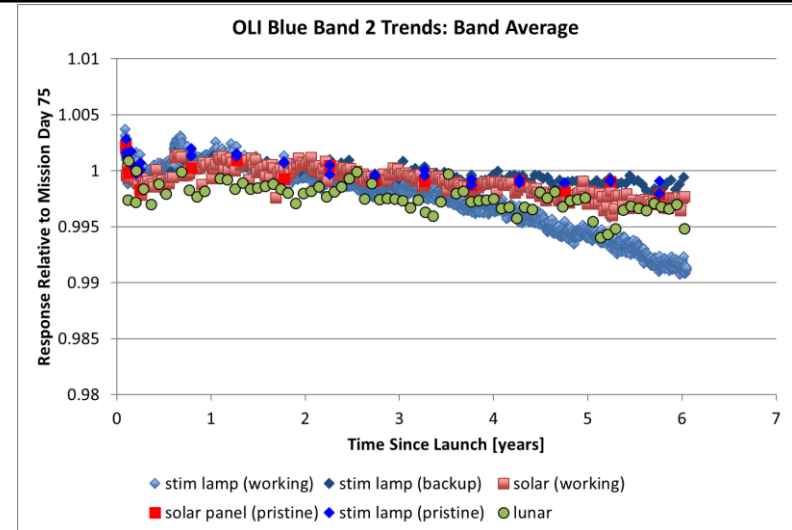
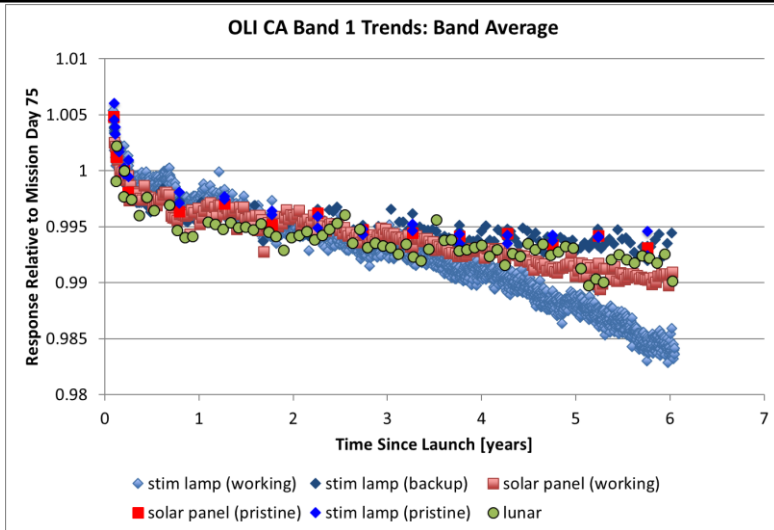
- **Introduction**
- **Landsat 8 Calibration Update**
- **Landsat 7 Calibration Update**
- **Geometric/DEM Improvements**
- **Collection 2**
- **L2 Validation**
- **Landsat 9**
- **Landsat 10**
- **Summary**

# Introduction

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- **USGS/EROS is responsible for the production and distribution of Landsat data (L1 – L5 MSS, L4 – L5 TM, L7 ETM+, and L8 OLI/TIRS).**
- **EROS is also involved in the development of Landsat 9.**
- **EROS CalVal is part of a larger calibration group including NASA/GSFC, NASA/JPL, Rochester Institute of Technology, South Dakota State University, and University of Arizona**

# L8 OLI Radiometric Stability



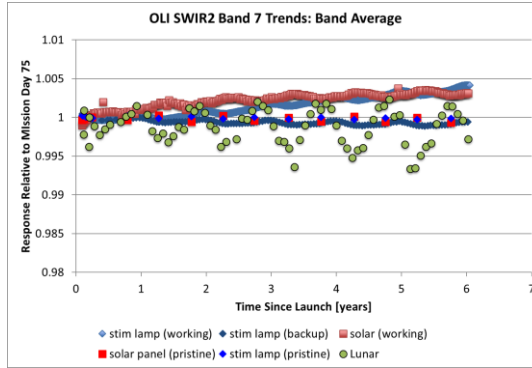
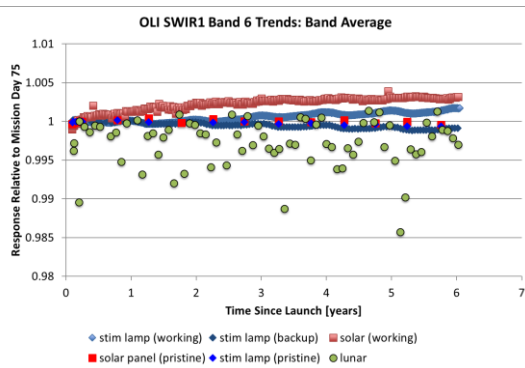
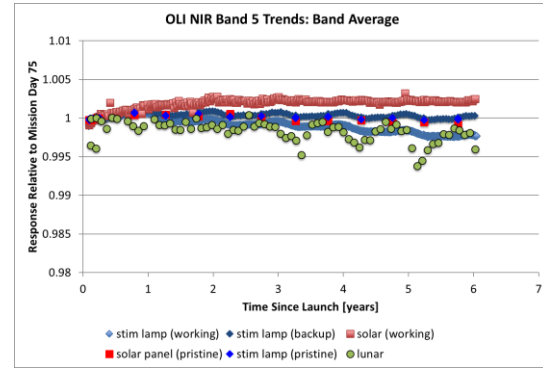
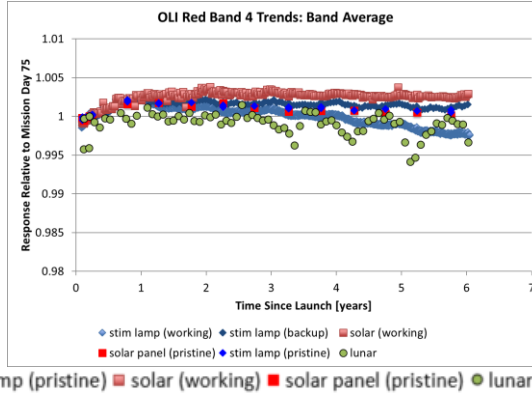
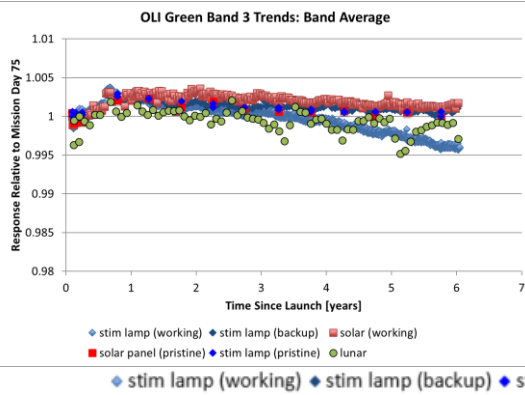
- **Overall radiometric response models are a weighted average of the responses from 2 stim lamps, 2 solar diffusers, and lunar collects**

- Working stim lamp (light blue) has been removed from the weighted model
- Possible degradation in working diffuser trend in CA band

- **Decay in sensor responsivity over the lifetime indicated by all calibrators**

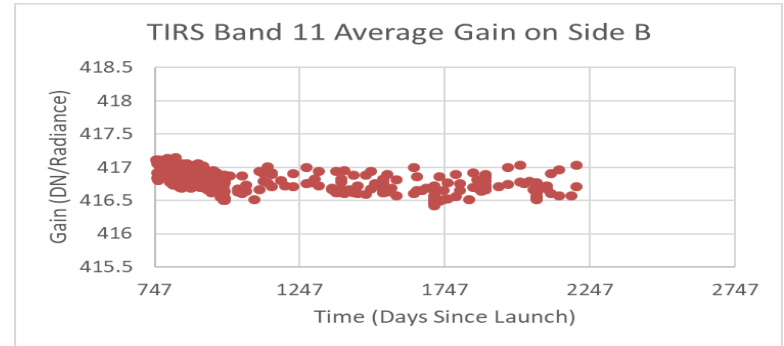
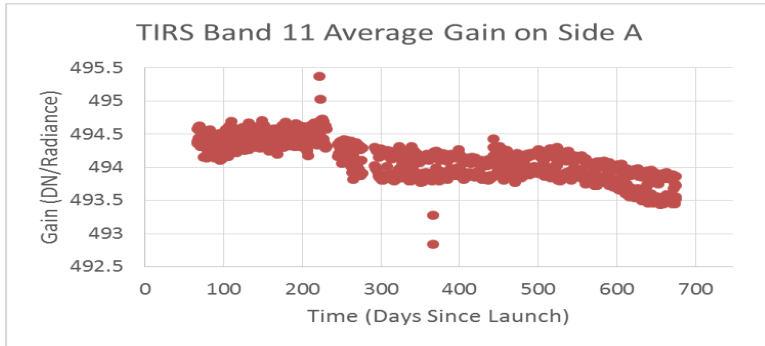
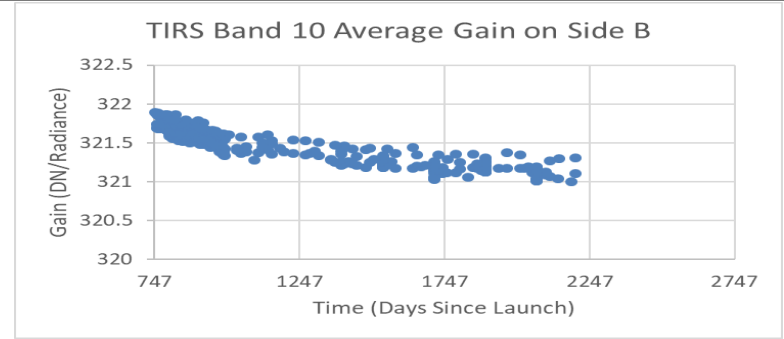
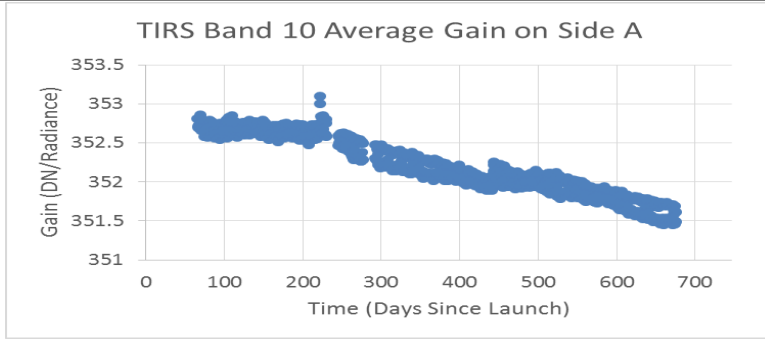
- CA band ~1.3%; Blue band ~0.25%

# L8 OLI Radiometric Stability (Cont.)



- Lunar collects show more variability at longer wavelengths
- No modeled decay for these bands

# L8 TIRS Radiometric Stability



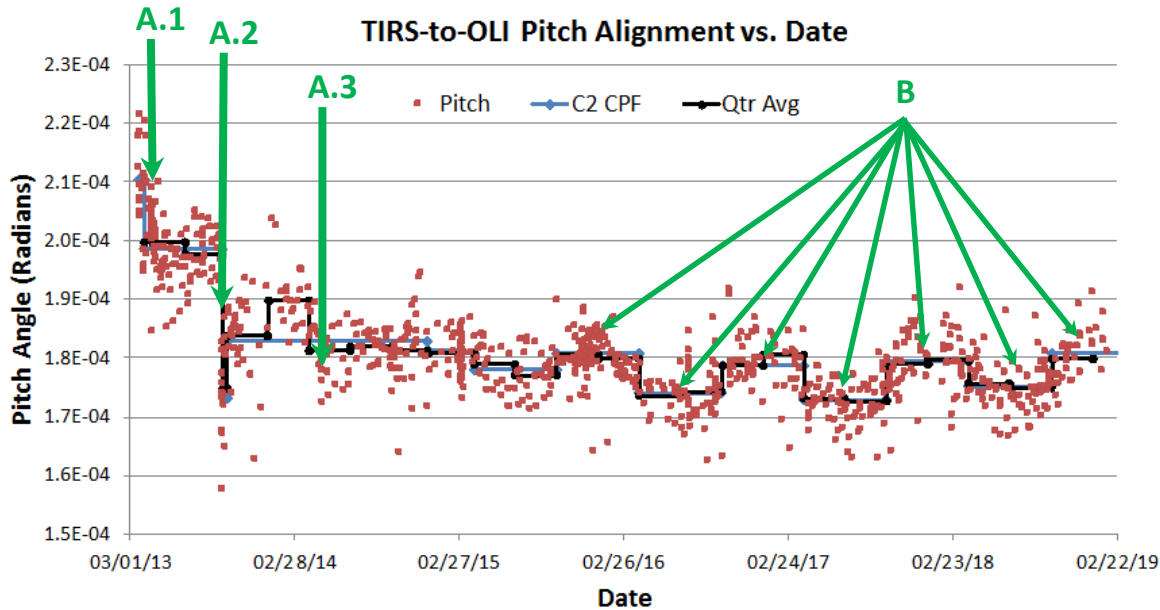
- Switch from side A to side B electronics due to scene select mirror current draw
- Side B shows better stability than side A
- Different ops con caused the different sampling rate seen in the side B plots.

# L8 TIRS-to-OLI Pitch Alignment vs. Date

## A. Measure TIRS-to-OLI alignment using TIRS 10.8 $\mu\text{m}$ and OLI SWIR1 bands

1. TIRS alignment changed as L8 maneuvered into the final orbit
2. A spacecraft anomaly in September 2013 caused a step change
3. A safe-hold event in April 2014 had a smaller impact

## B. A seasonal pitch variation in mode 0 data of $\sim 8 \mu\text{rad}$ will be corrected in the Collection-2 CPFs.



# L8 TIRS SSM Position Variation

- **TIRS cal events reset the SSM position model every ~14 days**

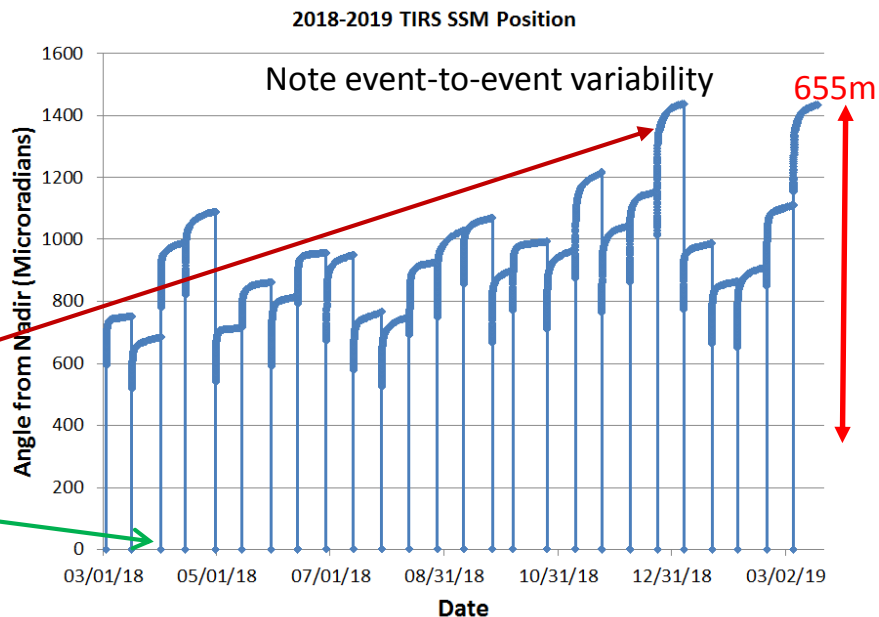
- SSM exhibits considerable variation in the magnitude of initial motion, so the initial motion is measured by leaving the encoder on for ~40 minutes

- **Subsequent motion is monitored using image measurements from cal scenes**

- Fit a model of SSM position to encoder and scene data
- SSM position angles vs. time are used in ground processing

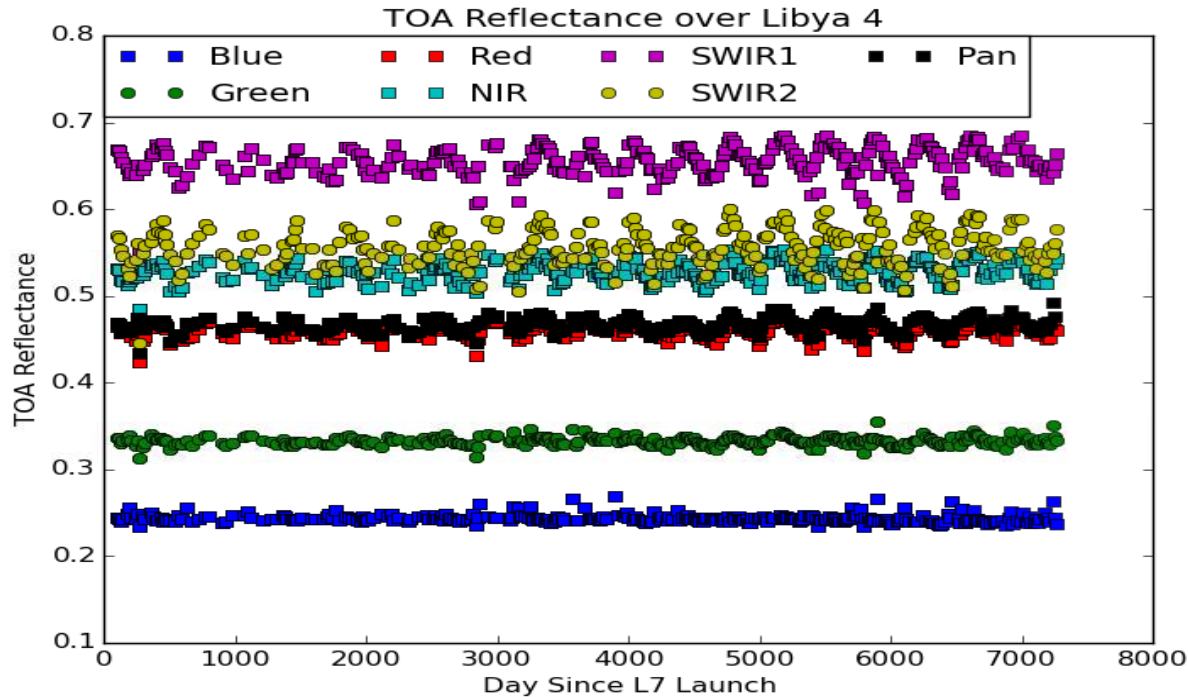
More extreme events since mid-2018

Each return to zero is a calibration event





# L7 ETM+ Radiometric Stability



**ETM+ radiometric stability is monitored over PICS (here Libya 4)**

**Longer wavelength bands show some seasonal variation**

**The data don't show any significant trends, so the current radiometric model is performing well**

# Landsat/S2 Registration Improvement Plan

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- **Perform global readjustment of the GLS control using L8 data with sparse ties to the Sentinel-2 Global Reference Image (GRI).**
  - Six triangulation blocks are being used to perform this global readjustment.
- **L8-only triangulations are complete for all blocks.**
  - New OLI GCPs were also extracted for all blocks.
  - The adjusted control is available for testing but is not yet being used for product generation.
- **When the S2 GRI L1C data become available (April 2019), we will re-run the triangulation solution with MSI control added to a subset of scenes.**
  - Some MSI control will be withheld to test the triangulation.
  - Validate using OLI-MSI image registration measurements.

# Digital Elevation Model Improvements

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- **ESA is procuring a global DEM.**
  - Recent information is that the 90-m/3-arcsec version will be publicly releasable but the 30-m/1-arcsec version will be restricted distribution based upon licensing.
- **Other DEM sources.**
  - National datasets in Scandinavia.
  - Newer data in Canada (CDEM), and Alaska (NED).
  - New reprocessed SRTM (NASADEM).
  - WorldView-derived ArcticDEM for high latitude islands.

# Collection 2

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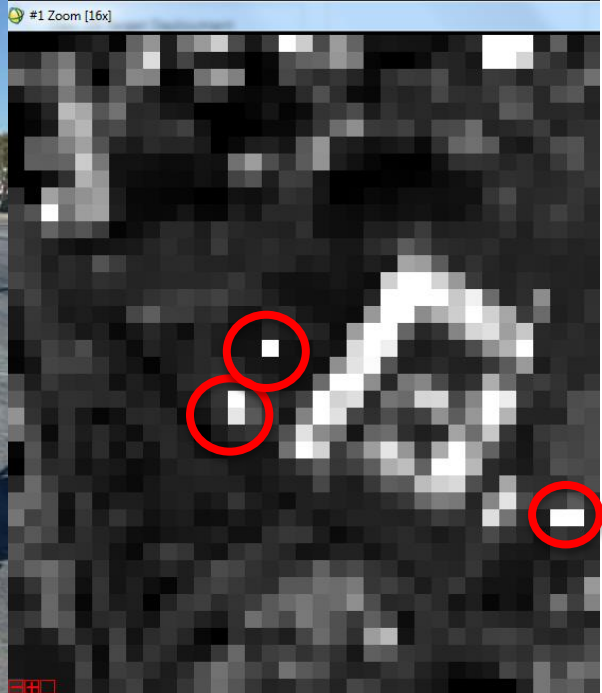
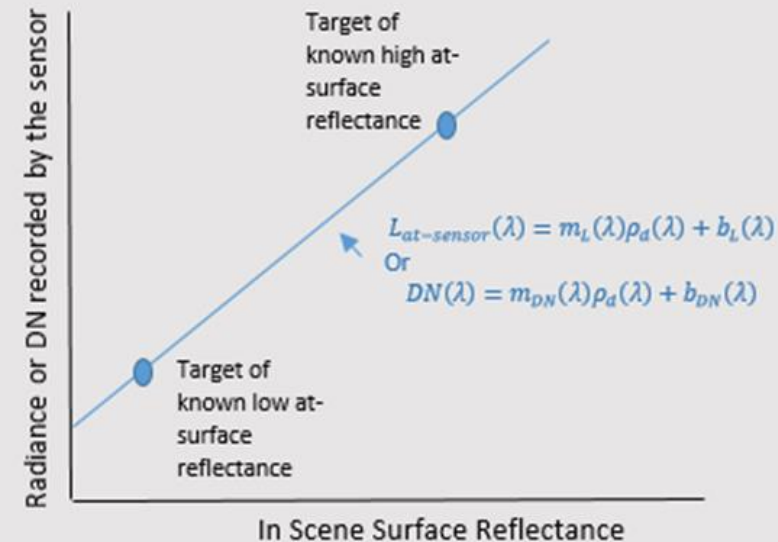
- **Currently Fall 2019**
- **Level 2 Surface Reflectance and Surface Temperature**
  - Caveat: Discussions still underway for producing Level 2 products in Collection 1
- **Improved Geometric Accuracy/Sentinel 2 Alignment**
- **L8 TIRS Absolute Radiometric Adjustment**
- **L8 OLI Retroactive Absolute Radiometric Adjustment (CA and Blue)**
- **L8 OLI to TIRS Seasonal Alignment**
- **L7 ETM+ Sensor/Band Alignment**
- **TM Thermal Absolute Radiometric Adjustment**

# L2 Validation

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- **Rochester Institute of Technology**
  - Develop light weight microbolometer sensor for surface temperature
  - Develop UAS deployment/measurement approach
- **South Dakota State University**
  - Develop mirror based surface reflectance measurement approach
- **University of Arizona**
  - Develop lower cost ground viewing radiometer for surface reflectance
- **Extensive Round-Robin Field Campaigns**

# L2 Product Validation (Mirror Based Approach)



# ARD

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- **US ARD (currently offered)**
  - Surface Reflectance and Temperature
  - Albers Equal Area (AEA) Conic map projection
  - Modified Web-Enabled Landsat Data (WELD) tiling scheme
- **Collection 2**
  - Surface Reflectance and Temperature
  - Universal Transverse Mercator / Polar Stereographic map projection
  - Scene Based
- **CEOS ARD for Land Compliance**

# Landsat 9

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- **OLI-2**
  - Finished all qualitative testing
  - Bounded to baseplate
  - Pre-Ship Review early Fall 2019
- **TIRS-2**
  - One more round of qualitative testing (finishing early summer)
  - Pre-Ship Review early Fall 2019
- **Launch Dec. 2020**



# Landsat 10

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- Sustainable Land Imaging (SLI) major objectives:
  - Collecting and archiving moderate-resolution solar reflective and thermal infrared image data
  - Ensuring that new data are sufficiently consistent with data from earlier Landsat missions
  - Free and Open access
- In U.S. Government Fiscal Year 2019, the joint NASA/USGS SLI Program established an SLI Architecture Study Team (AST 2019) to study designs and implementation approaches to provide continuous Landsat-quality measurements for at least 15 years or more starting in 2026.

# Summary

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- **The USGS continues to monitor the operational and past Landsat Missions**
- **The USGS is moving toward higher level (ARD) default products**
  - Continued commitment to calibration and validation
    - Moving to higher level products requires new cal/val methods
- **The USGS continues its role in the development of future Landsats**



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## EROS CalVal Center of Excellence (ECCOE) Workshop

by EROS CalVal Center of Excellence

Free



Register

SAVE THE DATE!

**September 23rd, 2019**

Annual eccoe WORKSHOP

Register to attend here:

<https://www.eventbrite.com/e/eros-calval-center-of-excellence-eccoe-workshop-tickets-58572955286>

### Date And Time

Mon, September 23, 2019

9:00 AM – 4:30 PM EDT

[Add to Calendar](#)

### Location

USGS, Reston Dallas Peck Auditorium

2201 Sunrise Valley Dr.

Reston, VA 20192

[View Map](#)



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## Joint Agency Commercial Imagery Evaluation (JACIE) Workshop-2019

by JACIE Management Team

Free



Register

### SAVE THE DATE!

September 24-26, 2019

18th Annual JACIE WORKSHOP

Register to attend here:

<http://jacieworkshop2019.eventbrite.com?s=84508608>

#### Date And Time

Tue, Sep 24, 2019, 8:00 AM -

Thu, Sep 26, 2019, 4:30 PM EDT

[Add to Calendar](#)

#### Location

Dallas Peck Auditorium at USGS

12201 Sunrise Valley Dr.

Reston, VA 20192

[View Map](#)